

## How structured and unstructured sport activities aid the development of expertise in volleyball players

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**How structured and unstructured sport activities aid the development of  
expertise in volleyball players**

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## 17 **Introduction**

18 In the past decades, researchers have sought to examine which particular attributes  
19 contribute most to excellence in sport, acknowledging the important role played by early  
20 developmental activities for the acquisition of skill and expertise (Côté, Baker, & Abernethy,  
21 2007; Côté & Erickson, 2015; Côté, Erickson, & Abernethy, 2013; Ericsson, Krampe, &  
22 Tesch-Romër, 1993). In a comprehensive paper, outlining an approach to the study of expert  
23 performance, Ericsson, Krampe and Tesch-Romër (1993) concluded that expertise is  
24 predicated on investment in intense, highly structured, specific and effortful activities, which  
25 are not particularly enjoyable and designed to improve performance, defined as deliberate  
26 practice. In their paper, the authors were particularly emphatic in declaring that "...high  
27 levels of deliberate practice are necessary to attain expert level performance" (Ericsson,  
28 Krampe, & Tesch-Romër, 1993, p392) (our italics). They also alluded to Simon and Chase's  
29 '10-year rule' (p.366) as a basis for establishing expertise in various domains including sports,  
30 and distinguished the relevance of deliberate practice from 'playful interactions' (p.368).  
31 These ideas have gained prominence in the sport sciences, and a body of work has attempted  
32 to show, that 10,000 hours (on average) of accumulated deliberate practice is a definitive  
33 requirement for achieving an expert level of performance (e.g. Baker, Côté, & Abernethy,  
34 2003b; Baker, Côté, & Deakin, 2005; Berry, Abernethy, & Côté, 2008).

35 Despite the prominence of the deliberate practice approach to expert performance, in  
36 recent years a significant lack of clarity has emerged in key findings. For example, the notion  
37 of a 10,000-hour 'rule' (Gladwell, 2008) has been heavily criticised for lacking substantial  
38 support (e.g., MacNamara, Hambrick, & Oswald, 2014). A major problem is that measures of  
39 variability in estimates of time spent in deliberate practice show great inter-individual  
40 differences in response. Tucker and Collins (2012) pointed out that reported practice time  
41 values ranged between approximately 3,200-23,000 hours in chess masters. Due to the large

42 variation in the number of hours needed in practice it has been suggested that the nature of  
43 the practice activities undertaken by developing athletes is a far more important stimulus for  
44 the acquisition of expertise, rather than the time spent practising (Davids, 2000; Hambrick et  
45 al., 2014).

46 In a systematic review, Coutinho et al. (in press) have also indicated that there may be  
47 potential negative consequences from early engagement in deliberate practice stimulated by  
48 undertaking such a vast number of hours of intense training during early development, a  
49 possibility acknowledged by Ericsson et al. (1993, see p.371). These consequences include  
50 burnout, dropout, overuse injuries and lower levels of attainment (see also Baker, Cobley, &  
51 Fraser-Thomas, 2009; Forsman, Blompvist, Davids, Konttinen, & Liukkonen, 2016; Fraser-  
52 Thomas, Côté, & Deakin, 2008a, 2008b; Law, Côté, & Ericsson, 2007; Wiersma, 2000).  
53 Consequently, some researchers have indicated that time spent in deliberate play during the  
54 early stages of athlete development may be more important as a formative experience in  
55 expertise achievement (for a review, see Côté et al., 2007; Côté & Erickson, 2015; Côté et al.,  
56 2013). In contrast to deliberate practice tenets, deliberate play emphasises fun and enjoyment,  
57 involving early developmental activities that are intrinsically motivating, and providing  
58 immediate gratification (Côté, Baker, & Abernethy, 2003; Côté et al., 2007; Côté & Erickson,  
59 2015; Côté et al., 2013).

60 These criticisms have led to the emergence of ideas about a number of developmental  
61 pathways that athletes might benefit from engagement in during early years toward expert  
62 performance (Côté, Murphy-Mills, & Abernethy, 2012; Ford, Hodges, & Williams, 2013).  
63 For example, the Developmental Model of Sport Participation (Côté, 1999; Côté et al., 2003,  
64 2007) suggests three different developmental trajectories, including: (1) recreational  
65 participation through early diversification and deliberate play, (2) elite performance through  
66 early diversification and deliberate play, and (3) elite performance through early

67 specialization and deliberate practice. Early diversification is based on the notion that  
68 children “sample” a wide range of sporting activities that involve higher levels of deliberate  
69 play and lower levels of deliberate practice before specialization (Côté, 1999; Côté &  
70 Abernethy, 2012; Côté et al., 2003, 2007). In contrast, early specialization includes an early  
71 start age in one sport and an early investment in deliberate practice (Baker, 2003; Baker et al.,  
72 2009; Wiersma, 2000). Early-diversified sport involvement allows children to experience a  
73 number of different physical, cognitive, affective, and psychosocial environments, which  
74 may enhance the intrinsic motivation that stems from the fun, enjoyment, and competence  
75 children experience in sport (Côté & Erickson, 2015; Côté & Fraser-Thomas, 2008; Côté,  
76 Horton, MacDonald, & Wilkes, 2009; Côté et al., 2012).

77         Although the theoretical background developed around early specialization-deliberate  
78 practice and early diversification-deliberate play has guided athlete development research in  
79 the past few years, some empirical evidence has also demonstrated that sport participation  
80 includes involvement in a number of other types of activities that differ from the original  
81 definition of deliberate practice and deliberate play (Berry et al., 2008; Côté et al., 2013;  
82 Ford, Ward, Hodges, & Williams, 2009; Ford, Yates, & Williams, 2010; Hopwood,  
83 MacMahon, Farrow, & Baker, 2015). Accordingly, the concepts of structured and  
84 unstructured activities have been used in literature (Berry et al., 2008; Fraser-Thomas et al.,  
85 2008b) in order to consider the composition of sport activities and support the inclusion of  
86 other important activities that are not considered in the original definitions of deliberate  
87 practice and deliberate play. Structured activities involve formal adult-led sport activities that  
88 include all kinds of organized training. In contrast to the original definition of deliberate  
89 practice (Ericsson et al., 1993), structured activities may also include specific pedagogical  
90 games designed to improve performance (Griffin & Butler, 2005; Launder, 2001; Light,  
91 2006) (i.e. practice activities not performed alone), practice activities that are enjoyable,

92 organized competition, observing others perform or engaging in activities that may lead to  
93 implicit learning (Maxwell, Masters, & Eves, 2000). Contrary to structured activities,  
94 unstructured activities include informal youth-led activities, developed in play environments  
95 like backyard or street games of basketball, football or hockey with siblings and friends. An  
96 important element of unstructured activities is that they provide an opportunity for children to  
97 hang out together and have fun playing games, which are often spontaneously created and  
98 adapted to specific locations and contexts in mind (like quiet streets, public parks or school  
99 yards, outside school times). In contrast to the original definition of deliberate play (Côté,  
100 1999; Côté et al., 2003, 2007), unstructured activities may also include spontaneous fun  
101 activities that are monitored by youth in their free time with the goal of improving skills or  
102 performance (e.g. basketball player practising shooting on her own in the backyard) (Côté et  
103 al., 2013). These activities are not systematically or pedagogically planned and are  
104 characterized by their extrinsic value of skill development (Côté et al., 2013). Unstructured  
105 activities may also include other informal play or physical activities like riding a bike or  
106 playing tag. This is an important distinction since unstructured activities comprise a high  
107 degree of novelty and variability exposing children to new physical, social and emotional  
108 situations, also allowing them to explore their independence and enhance their organisation  
109 and leadership skills (Côté et al., 2003, 2007; Côté & Erickson, 2015; Côté et al., 2013).  
110 Furthermore, flexibility in the structure and form of games provide children with the freedom  
111 to invent, adapt, and negotiate rules (and other characteristics), which promote the  
112 development of important characteristics of expertise in sport, such as innovation, creativity,  
113 adaptability, and flexibility (Côté & Erickson, 2015; Côté et al., 2013; Davids, Araújo,  
114 Seifert, & Orth, 2015; Ford et al., 2013; Memmert, Baker, & Bertsch, 2010). Bernstein  
115 (1967) proposed that such features form a hallmark of skilled behaviour, which he termed  
116 dexterity. Despite the obvious functional relevance of this type of activity, little attention has





142 data, but also by interpreting the meaning that athletes place on events, processes, and  
143 structures behind their development in sport (Poczwadowski, Diehl, O'Neil, Cote, & Haberl,  
144 2014; Readdy, Raabe, & Harding, 2014). By providing athletes with the freedom to use their  
145 own words when explaining their perceptions of their development in sport we aimed to  
146 enhance and complement existing data in this research field (Denzin & Lincoln, 2000; Miles  
147 & Huberman, 1994; Patton, 2002; Silverman, 2000).

#### 148 **Participants**

149 To achieve our aims, coaching staff members of 18 volleyball clubs in Portugal were  
150 recruited to help select participants for the study. The sample included 30 highly skilled and  
151 30 less skilled volleyball players (15 male and 15 female for each group). Participants were  
152 selected based on two main criteria: (a) being no younger than 23 years old (peak  
153 performance in volleyball is achieved in the mid to late twenties; Balyi & Hamilton, 2004),  
154 and (b), having a minimum of 10-years of sport-specific experience in volleyball, but with no  
155 prior limitations on the number of reported hours spent in sport participation. Additional  
156 criteria that we used to characterise the sample of highly skilled participants included:  
157 playing in the premier league (Helsen, Starkes, & Hodges, 1998; Low, Williams, McRobert,  
158 & Ford, 2013), belonging to a senior national team (Baker et al., 2003b; Hayman, Polman,  
159 Taylor, Hemmings, & Borkoles, 2011; Memmert et al., 2010) and being ranked amongst the  
160 best volleyball players by national team coaches (Baker, Côté, & Abernethy, 2003a; Berry et  
161 al., 2008). The less skilled players were regularly involved in recreational volleyball and had  
162 never been part of a senior national team.

163 All procedures followed the guidelines stated in the Declaration of Helsinki and were  
164 approved by the ethics committee of the first author's institution. Players were contacted  
165 personally or by telephone and were provided with an overview of the study – 100% of the  
166 players contacted agreed to participate in the study. Prior to the beginning of the study, all

167 players were given information sheets that informed them about the purpose of the study and  
168 signed consent forms.

### 169 **Data Collection**

170 An adapted version of the retrospective interview procedure suggested by Côté,  
171 Ericsson and Law (2005) was specifically designed to examine the sport participation  
172 histories of these Portuguese volleyball players. The interview design sought to gain an in-  
173 depth understanding of players' general patterns of activity involvement (training patterns)  
174 during their sport development. The procedure included closed- and open-ended questions to  
175 collect quantitative and qualitative data on participant training patterns throughout  
176 development, specifically considering their early developmental sport activities (i.e. the  
177 amounts of structured and unstructured activities undertaken). The interviews were conducted  
178 by the primary researcher in a quiet area, familiar to participants and free from distractions, in  
179 a face-to-face format, and took approximately 2 hours to complete. All interviews were audio  
180 recorded and transcribed verbatim.

181 **Quantitative data.** Quantitative data were collected in a series of tables and charts  
182 designed to assemble the information in an accessible and intuitive profile for both the  
183 primary researcher and the athlete. Training patterns were examined from a developmental  
184 perspective by calculating means of reported number of structured and unstructured activities  
185 experienced as well as the number of hours spent in these activities. Structured activities were  
186 defined as all sport activities undertaken in a formal, organised training setting such as a club,  
187 sport school or other organization, supervised by an adult (a coach or teacher) and had  
188 performance enhancement as their primary focus (examples: volleyball in a club, karate in a  
189 private martial arts school, swimming lessons with a personal trainer). Unstructured activities  
190 were proposed to involve voluntary play or physical activities undertaken in an informal  
191 environment, monitored and regulated by youth or someone involved in the activity, in which

192 the main purpose is to maximise enjoyment (examples: riding a bike, street basketball,  
193 backyard soccer, playing tag). These activities were analysed taking into account three  
194 developmental stages: 8 to 12 years, 13 to 16 years, and 17 to 20 years. These developmental  
195 stages were selected after a preliminary quantitative analysis of the data, in which some  
196 specific patterns differentiating participant development were highlighted. The  
197 developmental model of sport participation (Côté, 1999; Côté et al., 2003, 2007) was also  
198 used as the theoretical background to define each individual's developmental stages. Finally,  
199 the Portuguese volleyball federation competitive system was used to validate the age values  
200 of each stage. Accordingly, the first stage (8-12 years), second (13-16 years), and third (17-  
201 20 years) stages matched the different stages of training of the Portuguese volleyball  
202 federation.

203 **Qualitative data.** In order to facilitate participants' ability to discuss their sport  
204 development they were invited to use their own words to describe and explain in more detail  
205 their sport experiences throughout development. Main questions focused directly on their  
206 past developmental sport activities such as: "Could you elaborate on your sport involvement  
207 during childhood and adolescence by discussing experiences that you feel were significant  
208 for you?" Probing and follow-up questions were used to encourage athletes to expand their  
209 answers such as "Can you give me a specific example of how this type of activity was  
210 performed?" In sum, the qualitative part of the interview allowed athletes to focus on their  
211 previously identified sport experiences (quantitative part) and provided understanding of  
212 those experiences.

### 213 **Data Analysis**

214 **Statistical analysis.** All variables examined from a developmental perspective used a  
215 4 x 3 (Groups x Stages) analysis of variance with repeated measures (RM ANOVA). In this  
216 study, we considered four groups (i.e. highly skilled male, highly skilled female, less skilled

217 male and less skilled female) and three different stages of development (i.e. 8-12 years, 13-16  
218 years, and 17-20 years). Specifically, RM ANOVA was used to analyse training patterns (i.e.  
219 number of structured and unstructured activities practised, number of hours of structured and  
220 unstructured activities practised per year). Post hoc analyses were conducted using  
221 Bonferroni tests and effect sizes were determined using eta-squared values ( $\eta^2$ ). Greenhouse-  
222 Geisser adjustments were applied to violations of the sphericity assumption. To assess the  
223 reliability of the information provided by players in this study, follow-up interviews were  
224 conducted with 25% of the sample (15 players – three highly skilled male, four highly skilled  
225 female, four less skilled male, and four less skilled female). Pearson product-moment  
226 correlations were calculated between the information collected in time one and time two, and  
227 showed high correlations that varied between .702 and .995. Specifically, number of  
228 structured activities ( $r = .971$ ), hours of structured activities ( $r = .995$ ), number of  
229 unstructured activities ( $r = .813$ ), and hours of unstructured activities ( $r = .804$ ) showed high  
230 level of consistency between the information reported in the two interviews.

231       **Content analysis.** All interviews were digitally recorded, transcribed verbatim and  
232 checked for accuracy by a second member of the investigation team. Content analysis was  
233 used to analyse the data. The procedure of content analysis followed the previously  
234 established guidelines (Côté, Salmela, Baria, & Russel, 1993) within the academic literature  
235 on athletic development. First, the interview transcripts were divided into units of meaning  
236 (i.e. manageable pieces of text containing one unique point or theme; Côté et al., 1993).  
237 Second, the units of information with similar meanings were grouped into more  
238 comprehensive categories (Côté et al., 1993; Côté & Sedgwick, 2003), which allowed  
239 organization and interpretation of the unstructured data. Third, the content of these categories  
240 was re-examined carefully in order to search for commonalities and uniqueness according to  
241 the meanings by which they were categorized. Raw data themes were then identified and

242 built upon into themes and categories. After the completion of this process, we analysed the  
243 content using deductive techniques (Patton, 2002). The trustworthiness of the data was  
244 enhanced through two main strategies. First, participants were asked to review their  
245 transcripts for verification, which allow them the opportunity to add, delete, or rework any  
246 data that they felt did not accurately reflect their intended communications (Miles &  
247 Huberman, 1994). All informants agreed with the accuracy of their original communications.  
248 Second, two members of the research team were involved in a collaborative approach within  
249 the interpretational analysis, with regularly meetings to discuss the emerging categorical  
250 organization system. This important process contributed to the trustworthiness of the data,  
251 ensuring the interpretative validity while minimizing the risk of individual research bias  
252 (Silverman & Marvasti, 2008).

## 253 **Results**

### 254 **Training Patterns Throughout Development**

255 **Structured activities.** Descriptive statistics for amount of structured activities  
256 experienced and number of hours spent in these activities throughout development are  
257 presented in Table 1 and Table 2. A significant effect for stage was found on participants'  
258 reported number of structured activities ( $F(2,112) = 22.938, p < .001, \eta^2 = .291$ ). Pairwise  
259 comparisons of means across stages (Bonferroni adjusted alpha of  $p < .001$ ) revealed that  
260 players participated in significantly more structured activities during stage 1 ( $M = 3.0$   
261 activities/year,  $SD = 1.8$ ) and stage 2 ( $M = 2.3$  activities/year,  $SD = 1.4$ ) than in stage 3 ( $M =$   
262  $1.6$  activities/year,  $SD = 0.9$ ). There were no other significant main effects for the interaction  
263 between expertise level and gender in this variable. Concerning participants' reported number  
264 of hours spent in structured activities, a significant effect for stage ( $F(2,112) = 14.903, p <$   
265  $.001, \eta^2 = .210$ ) and interaction between expertise level and gender ( $F(6,112) = 5.289, p <$   
266  $.001, \eta^2 = .221$ ) was found. Pairwise comparisons of means across stages (Bonferroni

267 adjusted alpha of  $p = .001$ ) revealed that players accumulated more hours of structured  
268 activities in stage 2 ( $M = 1419.0$  hours/year,  $SD = 602.0$ ) and stage 3 ( $M = 1750.0$  hours/year,  
269  $SD = 897.1$ ) than in stage 1 ( $M = 1079.0$  hours/year,  $SD = 1113.0$ ). Moreover, highly skilled  
270 male and highly skilled female players accumulated more hours of structured activities than  
271 less skilled male players ( $p = .011$  and  $p = .030$ , respectively).

272

273 (please insert table 1 and table 2 around here)

274

275 **Unstructured activities.** Descriptive statistics for amount of unstructured activities  
276 experienced and number of hours spent in these activities throughout development are also  
277 presented in Table 1 and Table 2. There were no significant main effects for stage and  
278 interaction between expertise level and gender on players' reported number of unstructured  
279 activities. Analyses of the players' number of hours spent in unstructured activities revealed a  
280 significant effect for stage ( $F(2,112) = 21.214$ ,  $p < .001$ ,  $\eta^2 = .275$ ). Pairwise comparisons of  
281 means across stages (Bonferroni adjusted alpha of  $p = .010$ ) revealed that players  
282 accumulated more hours of unstructured activities in stage 1 ( $M = 1773.0$  hours/year,  $SD =$   
283  $766.2$ ) and stage 2 ( $M = 1062.0$  hours/year,  $SD = 588.1$ ) than in stage 3 ( $M = 547.8$   
284 hours/year,  $SD = 109.0$ ).

285 **Understanding the Role of Structured and Unstructured Activities Throughout Player**

286 **Development**

287 **Structured activities**

288 **Early diversified sport participation.** Both highly skilled (male and female) and less skilled  
289 (male and female) volleyball players mentioned having participated in significant amounts of  
290 structured activities during their early sport development:

291 Since I started practicing sports, it was a mixture of everything (sports) but nothing  
292 too *seriously or certain...then I definitely chose volleyball (HS female 1).*

293 When I was young, I did swimming, football, and volleyball everything at the same  
294 time. But then, when volleyball started to be more demanding and training loads was  
295 higher I have to choose volleyball (HS male 5).

296 **Early diversification with older peers.** Only highly skilled players (male and female)  
297 mentioned having participated in structured activities with older peers/teammates:

298 *In all sports I have practiced I always had older teammates... I used to be the*  
299 *youngest! (HS male 9).*

300 Sometimes was difficult to adapt myself to that specific sport, because they  
301 [teammates] were all older than me and they already know much more than what I  
302 knew (HS female 13).

303 **Volleyball participation with older teammates.** Only highly skilled players (male and  
304 female) mentioned practicing volleyball with older teammates:

305 Throughout my development in volleyball, I played and practiced all the time with  
306 older teams (HS male 10).

307 When I was 16 I started to play in the adult team. I always played with older athletes  
308 and this was very important for my development (HS male 1).

309 *I played during all my development in older teams...when I was 15 I was already*  
310 *practicing with the adult team and at that age I took part in my first official*  
311 *competition in that team! (HS female 6).*

312 *All the girls were older than me...they were very important to me because not only I*  
313 *learnt a lot with them, but also I learnt too quickly (HS female 4).*

314 **Unstructured activities**

315 **Involvement in unstructured activities.** Both highly skilled (male and female) and less  
316 skilled (male and female) volleyball players mentioned having participated in unstructured  
317 activities during their early development:

318 I never was a quiet child. I played a lot with my friends during my childhood. My  
319 parents were very poor and I never had the opportunity to have a PlayStation or  
320 something like that. I had nothing to do. So, I just played, played, and played in the  
321 street (HS male 5).

322 I think I started doing sports naturally. I lived in a small village and I could play a lot  
323 in the street with my friends and neighbours (HS male 12).

324 *I never was a quiet child. I loved play in the street! I couldn't stay too much time in*  
325 *the computer... I needed to go outside and play, even if it was alone!* (LS male 10).

326 **The potential of unstructured activities for expertise enhancement.** Highly skilled players  
327 (male and female) referred specifically to how unstructured activities provided an important  
328 formative experience that helped them develop physically, technically, tactically, cognitively  
329 and motivationally. They also directly implicated these experiences in their expertise  
330 development and achievement:

331 I reached expertise [in volleyball] because I played a lot in the street. I was not a  
332 gifted athlete and I had my own difficulties in sport. But just because I played it a lot  
333 in the street, I could develop my physical, technical, and tactical skills (HS male 1).

334 There are three major factors that helped me to reach expertise: first, because I loved  
335 and still love volleyball; second, because I work really hard on it; and third, because  
336 I play a lot in the street (HS male 2).

337 **Involvement in specific unstructured activities.** Highly skilled players (male and female)  
338 particularly indicated playing a lot of street volleyball and they emphasized the specific



339 contribution of this practice for their development. On the contrary, less skilled players  
340 reported playing other activities rather than volleyball:

341 Sometimes after the training session we went outside and play volleyball again. We  
342 *didn't even need anything. We held a thread somewhere or we use my grandmother's*  
343 *gate as a net and play during all afternoon (HS male 4).*

344 It is funny because the youth in my neighbourhood typically played football in their  
345 *free-times, in the break times at the school, in the street...but me and my friends were*  
346 *never like this! We spent our free times playing volleyball! (HS male 8).*

347 During my childhood, *when I was at home I was always playing volleyball...even*  
348 *alone! (HS female 7).*

349 Apart from physical education in kindergarten and primary school, I played a lot with  
350 my friends. I played football, I rode a bike, skateboarding, everything! But never  
351 volleyball! (LS female 2).

352 **Involvement in specific unstructured activities with older peers.** Only highly skilled players  
353 (male and female) mentioned having played specific unstructured activities with older peers:

354 I always played volleyball in the street with older peers. We used to play altogether  
355 *and I loved playing with them... (HS male 2).*

356 When I played volleyball in the street there was a mixture of younger and older  
357 *youths. But I know that I learned a lot with the older ones... (HS male 9).*

358 In that activities (street-volleyball) we played altogether, so there were younger and  
359 older peers. But all I wanted was to play with the older ones because they played  
360 *better than me... (HS female 3).*

### 361 **Discussion**

362 In this study, we examined the developmental pathways of highly skilled and less  
363 skilled volleyball players by exploring the formative nature of their sport experiences

364 (specifically the nature of structured and unstructured activities experienced) embedded  
365 within a simultaneous analysis of expertise level and gender.

366         Analysis of participant training patterns revealed that volleyball players had an early-  
367 diversified type of sport involvement with a greater involvement in structured and  
368 unstructured activities during stage 1 and 2 (sampling and specializing years), and an increase  
369 in the number of hours spent in structured sport activities during stage 2 and 3 (specializing  
370 and investment years). These findings are consistent with the tenets of the developmental  
371 model of sport participation (Côté, 1999; Côté et al., 2003, 2007) that suggests two sport  
372 participation trajectories related to talent development: (1) elite performance through early  
373 diversification and deliberate play, and (2), elite performance through early specialization and  
374 deliberate practice. Furthermore, these findings are in line with results of empirical studies in  
375 team sports showing early diversification as a possible pathway to both expert performance  
376 and recreational participation (Baker et al., 2003a; Berry et al., 2008; Coutinho, Mesquita,  
377 Fonseca, & Côté, 2015; Coutinho, Mesquita, Fonseca, & De Martin-Silva, 2014; Leite,  
378 Baker, & Sampaio, 2009; Leite & Sampaio, 2012). The data suggested that sampling  
379 different sports during the early years of athletic development provides a good foundation for  
380 both highly skilled and less skilled sport engagement. The early diversification pathway has  
381 been associated with several benefits, including a prolonged engagement in sport, more  
382 enjoyable and positive early sport experiences, and a healthy physical, psychological and  
383 social development (Baker, 2003; Baker et al., 2009; Côté et al., 2007; Côté et al., 2012;  
384 Fraser-Thomas et al., 2008a, 2008b). An early-diversified sport involvement may also protect  
385 athletes against the potentially negative consequences of early specialization such as physical  
386 injuries, a decrease of enjoyment in sport, and dropout (Fraser-Thomas, Côté, & Deakin,  
387 2005; Fraser-Thomas et al., 2008a, 2008b; Law et al., 2007). Beyond that, research has also  
388 acknowledged the importance of engagement in unstructured activities during childhood for

389 an athlete's development (Côté et al., 2007; Côté & Erickson, 2015; Côté et al., 2013; Wood,  
390 2013). These activities are personally directed, chosen freely and regulated by children,  
391 providing them the opportunity to decide and to invent what to do and how to do it. This  
392 experience leads to a complete, active, and intense involvement in the activity providing good  
393 conditions for learning (Côté et al., 2013). Furthermore, the flexibility in the structure and  
394 form of early sport experiences, as well as their high degree of novelty and unpredictability,  
395 expose children to many new physical, social, and emotional situations, which provide a  
396 platform for the development of metacognitive capabilities, learning and overall development  
397 in sport (Côté et al., 2013; Wood, 2013).

398         While highly skilled and less skilled volleyball players reported participating in  
399 essentially the same type of structured and unstructured activities, highly skilled players  
400 accumulated more hours of structured practice throughout development. This finding is  
401 consistent with results reported in previous literature suggesting a relationship between  
402 investment in hours of practice and expertise achievement (Baker et al., 2003b; Baker et al.,  
403 2005; Berry et al., 2008; Hopwood et al., 2015; Schorer et al., 2015). However, the total  
404 number of hours of structured activities accumulated by highly skilled players (between  
405 2,000 and 5,300 hours) is far less than the 10,000 hours suggested by Ericsson and  
406 colleagues' original study (Ericsson et al., 1993) and popular books (e.g. Gladwell, 2008) as a  
407 benchmark for attaining expertise. In fact, studies carried out in team sports have shown that  
408 players have achieved expert performance after accumulating between 4,000 to 6,000 hours  
409 of sport-specific practice (Baker et al., 2005; Berry et al., 2008; Soberlack & Côté, 2003),  
410 supporting the recent clarification of Ericsson (2013) on highlighting that "there is nothing  
411 magical about exactly 10,000 hours" (p. 534).

412         In addition to these findings, in-depth analysis of how structured and unstructured  
413 activities were specifically experienced throughout development revealed key important

414 differences between the groups. The current study extends previous findings by  
415 demonstrating that, not only do highly skilled players spend more time in structured  
416 activities, but they also were involved in these activities (in which the primary sport,  
417 volleyball, is included) with older peers or teammates. Previous work has highlighted the  
418 benefits of playing and practicing with older peers for athlete and expertise development  
419 (Balish & Côté, 2013; Côté, MacDonald, Baker, & Abernethy, 2006; MacDonald, Cheung,  
420 Côté, & Abernethy, 2009; MacDonald, King, Côté, & Abernethy, 2009). It could be argued  
421 that the training environment and psychosocial climate induced by older peers improve  
422 players' motivation to practice, promoting a deeper immersion in a sport activity, and  
423 consequently leading players to a more active engagement in learning (Wood, 2013).  
424 Furthermore, older peers and teammates can act as important role models affording players  
425 the opportunity to form attitudes and behaviours through the process of observational  
426 learning (Bandura, 1977), what Rietveld and Kiverstein (2014) have called the 'form of life'  
427 in a domain of expertise. Notwithstanding, this finding could also possibly be viewed as a  
428 result of the athletes' already superior talent at that age. In structured sporting programmes,  
429 younger athletes who are highly skilled could be moved up to play with and compete against  
430 older players because they are considered to be talented and their performance could be  
431 profitable to the older team. Such a phenomenon could be considered an athletic career  
432 transition (Alfermann & Stambulova, 2007), which is defined as a turning phase in career  
433 development that manifests itself by sets of demands athletes have to meet in order continue  
434 successfully in sport. Successfully coping with transitions improves the athlete's odds of  
435 having a long and successful life in sport (Stambulova, 2010). Although little is known about  
436 the potential of such a transition in sport (i.e. starting to play and competing with older  
437 athletes), possibly due to the disconnection of talent development and career transitions  
438 research (for a review, see Coutinho et al, in press), coaches and sport systems should

439 analyse carefully each particular case in order to understand and decide what is the best for  
440 each individual athlete's personal and talent development.

441         Additionally, highly skilled players explained how unstructured activities might have  
442 helped them developing physically, technically, tactically, cognitively and motivationally,  
443 which could have been an important contribution to their expertise development and  
444 achievement. From a skill acquisition perspective, involvement in this type of child-led  
445 activities allow children to experience sports in various contexts with freedom to invent,  
446 adapt, create, and negotiate activities and rules to suit to their own wishes and needs (Côté et  
447 al., 2007; Côté et al., 2013). These factors promote a stimulating environment in which  
448 athletes develop their physical, technical, and tactical attributes, but also learn the "game  
449 smartness" that can be challenging to acquire within a more formalised, structured sport  
450 training environment. Indeed, the development of dexterity (Bernstein, 1967) (i.e.  
451 adaptability and creativity) promoted by the involvement in unstructured activities has been  
452 posited as the mechanism supporting the empirically highlighted benefits of these informal  
453 activities on skill acquisition and sport expertise (Berry et al., 2008; Côté et al., 2007; Côté et  
454 al., 2013; Ford et al., 2009; Memmert et al., 2010). Interestingly, while the quantitative  
455 results of this study did not show significant differences in the number and hours of  
456 unstructured activities between groups, highly skilled players reported their engagement in  
457 specific unstructured activities with older peers (i.e. volleyball play activities away from  
458 supervising adults). Thus, it could be argued that skilled and less skilled players had a similar  
459 quantity of unstructured activities, but the distinction could be in the type and quality of such  
460 experiences. It has been suggested that these types of informal experiences in the primary  
461 sport foster the development of decision-making (Roca, Williams, & Ford, 2012), attainment  
462 (Ford et al., 2009) and creativity (Memmert et al., 2010). Thus, involvement in specific  
463 unstructured activities with older peers may have enhanced all these benefits during the

464 development of highly skilled volleyball players. The flexibility and negotiability in structure  
465 and form of unstructured activities enable children of different abilities and ages to play in  
466 the same game without losing the fun and enjoyment of competition, promoting therefore a  
467 productive learning environment (Côté et al., 2003). Considering the potential contribution of  
468 unstructured activities for athlete and talent development, administrators in governing bodies  
469 and sport systems should reflect on encouraging and creating more opportunities for such  
470 experiences. Possible strategic actions that may promote opportunities for involvement in  
471 unstructured activities could be facilitated at the organizational and social support levels. At  
472 the organizational level, it could be beneficial to increase the construction of outdoor spaces  
473 where children can play safely and enhance the availability of sport clubs and schools  
474 facilities during free time for children to play with specific materials (e.g. balls, volleyball  
475 net, trampolines, etc). At the social support level, it could be important to increase the  
476 awareness of parents, coaches, teachers, and administrators about the importance of  
477 children's involvement in unstructured sport activities that are not always directed and  
478 monitored by adults.

479         Despite the important findings of this study, there are some limitations that should be  
480 addressed. Portuguese volleyball is not considered to be at a world-class -level, which should  
481 motivate other researchers to examine the developmental pathways of high-level volleyball  
482 players. Furthermore, although retrospective methodologies have been considered an  
483 incomplete tool to collect accurate data in this research field (Côté, et al., 2005; Coutinho et  
484 al, in press), they reflect the players' perceptions of their previous sport experiences, which  
485 need to be triangulated with more objective data regarding developmental patterns (Sosniak,  
486 2006). Notwithstanding, our study afforded important insights into this research field  
487 attesting the usefulness of mixed methodologies and qualitative methodologies as a valuable  
488 approach to analyse and explain skill and talent development in a deeper and contextualized

489 way. Future studies should consider the potential of prospective longitudinal designs to  
490 specifically examine the athletes' developmental sport experiences so as to better understand  
491 the contributions to developing and attaining expertise in volleyball and other sports. Here, a  
492 detailed examination of the microstructure of practice and play could provide important  
493 insights into what really differentiates learning activities performed in different stages of  
494 development by skilled and less skilled players. Furthermore, qualitative methodologies  
495 should also be considered in further studies as a valuable procedure for an in-depth analysis  
496 and interpretation of the processes of athlete talent development.

### 497 **General Conclusions and Practical Implications**

498         The findings of this study support previous research suggesting early sampling as a  
499 suitable pathway for both adult expert and non-expert performance development. Highly  
500 skilled and less skilled players were involved in several sport activities during the early years  
501 of their sport participation, with a gradual increase in the number of hours spent in structured  
502 activities throughout development. The novel contribution of this study emerged from highly  
503 skilled players highlighting participation in structured and unstructured activities with older  
504 peers as well as the involvement in specific unstructured activities (i.e. volleyball child-led  
505 play activities) as key factors for their expertise development and achievement. These  
506 findings suggest the need for deeper examinations of practice histories since athlete  
507 development characterizations based on a general portrait of early specialization or early  
508 diversification seem insufficient to understand how expertise in sport is acquired. Additional  
509 research is needed to examine in greater detail the type of practice undertaken by athletes  
510 throughout development considering the possible coexistence of what are currently deemed  
511 as opposing and contrasting learning activities (for instance, the presence of specific practice  
512 and play activities within a diversified sport involvement as shown in this study). Following  
513 the propositions that talent development is a nonlinear, inherently noisy and dynamic process,

514 emphasising the acquisition of increasingly functional relationship with a performance  
515 environment (Davids, Shuttleworth, Araújo & Gullich, in press) , there is a need to move  
516 beyond mechanistic and prescriptive models of talent development (which tend to model the  
517 process according to stratified and fixed stages, while outlining putative practice  
518 characteristics based on these categorisations). The data reported here suggest that there is a  
519 need for future research to test the validity of an additional talent development pathway to  
520 elite performance through a sophisticated mix of structured (adult-led) and unstructured  
521 (peer-led) play and practice, which can allow talented athletes to exploit the value of play and  
522 organised training in acquiring expertise in sport (Davids, Shuttleworth, Araújo & Gullich, in  
523 press). This type of research would provide a consideration of features of best practice and  
524 process markers of talent development, leading to the emergence of robust guidelines for the  
525 implementation of this pathway applied in practice. Further research should also consider the  
526 influence of other contextual factors in determining the quality of practice, since practising  
527 and playing with older peers was a key factor for expertise achievement in this study.  
528 Accordingly, broadening our attention to encompass larger systems in which athletes develop  
529 will create new insights into athlete and talent development. Here, exploring the use of  
530 qualitative research in a more consistent and deeper way may provide better understandings  
531 of the complex interaction of different factors (e.g. type and quantity of practice and play;  
532 peers, coach and family influence) and their influence in determining expertise achievement.

533 A number of important practical implications for sport practitioners can also be drawn  
534 from the data. What is clear from this study is that highly skilled players' development  
535 pathway is characterized by a greater quantity of practice and more enriched learning  
536 contexts throughout development (resulting from their involvement in early specific  
537 unstructured activities, as well as regular practice and play with older peers/teammates).  
538 Coaches should, therefore, consider not only the amount of practice but also the overall



539 environment in which practice activities are experienced (e.g. peers age, the degree of  
540 formality and specificity of practice), since these factors could determine the quality of  
541 practice. Coaches and sport systems should also consider the role of unstructured activities in  
542 the early years of athlete development as this type of learning context may provide additional  
543 stimuli in developing important attributes (e.g. technical, tactical, physical, cognitive,  
544 motivational) for expertise development and achievement. Sport administrators are  
545 encouraged to provide more specific and accurate long-term athlete development guidelines  
546 particularly regarding the early years of development due to the importance of this  
547 developmental stage for athlete development and commitment to sport. A comprehensive  
548 outline of all these issues would further our understanding of the factors underpinning the  
549 achievement of expert performance in sport.

550

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555

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754  
755

Table 1

Descriptive statistics (mean and standard deviation) for number and hours of structured and unstructured activities examined from a developmental perspective

	8-12	13-16	17-20	Total
N° of				
structured activities	3.0 (1.8)	2.3 (1.4)	1.6 (0.9)	6.8 (3.1)
Hours of				
structured activities *	1079.0 (1113.0)	1419.0 (602.0)	1750.0 (897.1)	4247.0 (1975.1)
N° of				
unstructured activities	1.6 (1.0)	1.6 (1.1)	1.3 (1.1)	4.4 (2.1)
Hours of				
unstructured activities *	1773.0 (766.2)	1062.0 (588.1)	548.0 (109.0)	3382.0 (1300.0)

\* Time in hours per year

Table 2  
 Descriptive statistics (mean and standard deviation) for number and hours of structured and unstructured activities examined from a developmental perspective according to expertise level and gender

		Highly Skilled Male				Highly Skilled Female				Less Skilled Male				Less Skilled Female			
		8-12	13-16	17-20	Total	8-12	13-16	17-20	Total	8-12	13-16	17-20	Total	8-12	13-16	17-20	Total
N°	of																
structured	activities	3.7 (2.1)	3.1 (1.1)	1.9 (1.0)	2.9 (0.3)	2.6 (1.6)	1.9 (1.2)	1.7 (0.9)	2.1 (0.3)	2.5 (1.1)	2.2 (1.4)	1.3 (0.7)	2.0 (0.3)	3.1 (2.1)	1.8 (1.6)	1.4 (0.8)	2.1 (0.3)
Hours	of																
structured	activities *	1060.0 (615.0)	1501.0 (564.1)	2671.0 (1051.0)	5231.2 (1478.0)	1197.3 (1887.0)	1721.0 (751.4)	2060.0 (565.1)	4978.0 (2715.0)	798.4 (386.2)	1155.3 (285.0)	1142.0 (158.0)	3096.0 (457.0)	1258.4 (999.4)	1298.0 (606.0)	1127.2 (347.4)	3683.2 (1819.3)
N°	of																
unstructured	activities	1.9 (0.5)	2.2 (1.4)	1.6 (1.2)	1.9 (0.9)	2.3 (1.1)	2.0 (1.4)	1.3 (1.1)	1.9 (1.1)	1.6 (0.6)	2.1 (1.3)	1.8 (1.2)	1.7 (0.8)	2.3 (1.3)	1.9 (0.7)	1.8 (0.7)	2.0 (0.8)
Hours	of																
unstructured	activities *	2522.0 (1048.3)	1540.0 (901.0)	684.0 (380.1)	4745.0 (1146.3)	1560.0 (977.0)	676.0 (351.3)	327.1 (183.1)	2562.0 (1264.0)	1361.2 (699.4)	1083.2 (675.2)	642.0 (362.3)	3086.0 (2242.0)	1648.1 (726.1)	947.0 (358.4)	539.2 (161.2)	3134.2 (1352.2)

\* Time in hours per year